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Global Surgery Hackathons: A Case Study From Pakistan

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Abstract

Background. Hackathons aim to solve problems in a selected field by bringing together people from multiple domains and combining their expertise. Global surgery is an emerging field with a huge burden of disease and massive implications for bettering health care. In this study, we describe the first Global Surgery Hackathon held in Pakistan and analyze the impacts of the hack and post-hack incubation. *Methods.* This research study used data collected from a Hackathon held at the Aga Khan University (AKU) in Karachi, Pakistan, and progress from the post-hack incubation teams. Data were collected from applications, from sign-in attendance, via evaluation forms, and milestone tracking of the incubation teams. A list of factors such as sectors addressed by winning projects and grants received was made. *Results.* The evaluations provided by the participants were positive, with mean scores of 4.00 (SD = .78) out of 5 on a Likert scale. Pitches made (n = 69, 68%) by the 109 participants were sorted into 5 categories: workplace, access, quality, safety, and design. Fifteen teams were formed, out of which 5 were accepted for incubation. All teams had a minimum viable product at the one-year mark. *Conclusion.* Hackathons are a reliable way to come up with effective solutions for targeted problems in various areas of health care and using the methodology of a Hackathon, a pool of low-cost, innovative solutions can be generated. These solutions can definitely impact health outcomes, especially for the field of global surgery. Further statistics should be collected to affirm the incubated solutions' impact.

Keywords

Aga Khan University, critical creative innovative thinking forum, global surgery, hackathon, incubation, innovation, low-middle-income country, Pakistan

Introduction

Low–middle-income countries (LMICs) are plagued with infrastructure problems that lead to limited access to surgical healthcare facilities and delayed provision of care.[1] Pakistan suffers from a deficit of 17 million surgeries a year, which is significant because deaths preventable by the administration of surgery exceed the death toll by infectious diseases.[2] The field of health care that concerns itself with the supply of surgical care to underserved populations is known as global surgery. It is a field of medicine that aims to improve health outcomes for people that have a need for surgical care, particularly focusing on populations whose needs are not being met as well as populations experiencing disasters.[3]

In March 2019, to explore the problems faced by Pakistan regarding surgical access and provision, the Department of Surgery at the Aga Khan University Hospital (AKUH), situated in Karachi, decided on global surgery as the theme for the annual surgery conference that year. The organizers wanted to be original, innovative, and action-oriented, and thus the idea of hosting a Hackathon within the conference was floated around and eventually accepted.[4]

Hackathons are 2–3 day events organized around a field where people representing multiple areas of expertise come together and tackle different problems, design solutions, and pitch them to a panel of judges. Although Hackathons started out as coding competitions, the format has been used in many different disciplines to great effect. MIT held the first medical Hackathon in 2011, and since then there have been many Hackathons organized around different sub-specialties of medicine all over the world.[5] This format is suited to the rapid development of novel solutions due to the collaborative environment, competitive nature and fast

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paced, disruptive mode of problem identification, and solution creation that such events encourage. Traditional barriers to innovation such as disciplinary echo chambers and inertia are overcome as fresh perspectives, and entrepreneurial motivations are added to the mix, creating a wide range of possible interventions.[6] If the solutions proposed during a Hackathon manage to attract interest from the judges, sponsors, or other investing bodies, the teams responsible may acquire funding and start development. An incubator is an entity that provides fledgling start-ups (incubates) with workspace, required expertise, seed funding, and other resources in order to help them develop themselves into companies.[7] The Critical Creative Innovative Thinking (CCIT) forum, situated in Aga Khan University (AKU), has an in-house incubator which had been accepting projects from prior Hackathons to incubate them and would do so again for this Hackathon's participants.

In order to determine if Hackathons could provide effective solutions to problems in surgical access and provision, we aimed to track the impact of the Hackathon as well as the post-Hackathon incubation process and project the gains made from its solutions. To this end, we have compiled evaluation data and incubate progress reports from a Hackathon held at AKU, as well as comparison data from 2 other global surgery themed Hackathons from around the world.

Materials and Methods

Study Design and Setting

We conducted a study on the fourth Hackathon organized at AKU in March 2019, a major quaternary-care teaching hospital in Pakistan. The event's name was *Global Surgery Hackathon*, with the theme to *hack* problems (i.e., to find efficient and novel solutions) in global surgery, and the objectives were defined to be "provision of accessible, affordable, acceptable, and quality (safe) surgical care to underserved, displaced, or under crisis populations of Pakistan." The sub-objectives were identifying strategies to raise the quality of healthcare personnel (medical and allied), suggesting models for the development of adequately equipped and staffed healthcare units, proposing processes to monitor surgical coverage and outcomes, and identifying resources for establishing sustainable surgical care services, all in the context of resource-constrained communities in Pakistan. Included in Supplementary Appendix 1 is the information given to participants in each *Hackbook*, a manual with all the necessary information for the event. The event was attended by participants from AKU and other institutions.

Main Outcome

Our main outcome was measurable impact in the field of global surgery through the Hackathon and the post-Hackathon incubation cycle. We achieved this through analyzing the pitches made at the event and incubate team progress in terms of diversity of issues explored, potential health impact, and funds raised. Data were collected from applications and again on the day of the event by asking participants to sign in on attendance forms. We combined these data with evaluation forms collected from all participants at the end of the Hackathon to access satisfaction levels of the Hackathon itself. We further matched it with the progress made by all incubate teams at the one-year mark.

Inclusion and Exclusion Criteria

All participants ("*hackers*") at the Global Surgery Hackathon who completed the post-event survey were included in the study as evaluators of the impact of the event. For the participating teams, only those who were selected for the incubation program were included for the tracking of milestones and impact calculations.

Planning

Six months before the event, the Critical Creative Innovative Thinking (CCIT) forum, AKUH's innovation, and incubation hub, began planning for the Hackathon. With 3 Hackathons organized over the last 3 years,[8] the forum members had ample experience in organizing Hackathons and accepted the invitation to co-host it with an upcoming surgical conference. Therefore, the Hackathon was debuted as a sub-event coming under the National Health Sciences Research Symposium Global Surgery conference. To help cover costs for organizing and executing the Hackathon, $7500 of funding was acquired from academic sponsors within the university and was used to pay for the required logistics, judge and mentor recruitment, and event prizes. Two months before the start of the event, the CCIT forum began marketing the event through internal organizational emails and social media. Prior collaborations with other universities were utilized to market for a diverse participant pool from multiple disciplines. Registrations for the event were opened, and the form included free text boxes for participants to submit specific problem pitches/pain points they or their loved ones may have noted in the surgical healthcare system that they believed needed to be hacked for the development of appropriate solutions. The registration forms were screened for suitable participants, and the selected people were given the green light to pay a small entry fee and secure their position in the event.

Opening Ceremony

On the 25th of January at 2:00 PM, participants showed up to the Center for Innovation in Medical Education, an AKUH building designated as the venue. They checked in, were given a name tag and a folder with a *Hackbook* (pamphlet with schedule and necessary information) inside, and were asked to sign an IP agreement whereby any intellectual property arising from the Hackathon—either from an individual, or a group—would be considered Joint Knowledge—meaning all participants had equal rights, and access to all Participant IP generated during the Hackathon. Furthermore—all participants had to agree to grant AKU all Joint Knowledge and Participant IP—and all subsequent matters related to IP would be managed in accordance with AKU's IP policy. The first day consisted of participants being introduced to the event and its structure, with keynote talks delivered by the organizers and some guest speakers. After a Q&A session, the process of problem pitching was explained.

Problem Pitching

The participants were then called on to formulate a pitch, which is a problem statement that every participant would come up on stage and announce, in the span of 60 seconds, as the dedicated problem they would like to find a solution for at the event. The pitch was numbered and then recorded next to the name of the presenting participant on large screens across the hall.

Team Formation

Afterward, the participants spent some time mingling, with discussions opening up around similar aims and groups forming together around those discussions. The participants were given 40 minutes to form teams and finalize a team name and their designated problem. Team sizes were capped at 9, and urged to be around 6, with a minimum team size of 4. Teams were encouraged to be multidisciplinary, and requests for specific personnel made by teams were entertained and broadcasted to the participants. No participant was assigned or placed, however. The entire group formation process was kept as organic as possible. Once the process had completed, everyone was given further instructions regarding problem dissection and the sharing of team resources (stationery, chart paper, and laptops). Since the event was held as a sub-event to the surgical conference ongoing at the time, the next time these teams would meet would be a week from then, on the second of February, toward the end of the conference. With this in mind, the teams were given their final instructions before they left at 4:30 PM.

Hacking

The event resumed on the second of February, 2019, 8:30 AM, with a week being given to the participants to communicate with each other. The design is unique to this Hackathon among most other medical Hackathons, which typically last for a maximum of 3 consecutive days.[9] After breakfast was provided, the day's schedule was highlighted for them, and participants were shown the records of a survey conducted among non-large public sector hospitals as a reference for the system they were trying to change. Right afterward, each team presented their name and problem. Three hours were given to them for hacking and solution development, during which mentors acquainted with various spheres of the health care and entrepreneurial space assisted them by listening to the ideas they had come up with, giving advice and answering questions. Then followed an hour-long lunch break.

Presentation Crafting

One and a half hours were given to all teams to start working on their presentations and seek advice specifically to that end from mentors and organizers. They were encouraged to use a presentation template provided to them by the CCIT forum. Then followed an hour-long "pulse check": a guided dancing session that has traditionally been performed at every Hackathon held in AKUH, accompanied by a remix of the Cha Cha Slide (the Harlem shuffle) with *bhangra* steps to recuperate the hackers' strength and spirit. The next 3 hours were spent in a grueling series of mock presentations and refinements before the second day was called to a close.

Final Presentations

The last day of the Hackathon began by 9:00 AM on the third of February, 2019. After some pertinent addresses by guest speakers, the Hackathon presentations were given by participants from each team, and the 5 appointed judges scored them according to a predetermined marking criteria that had been given to each participant in their Hackbook. The criteria had to do with the impact of the proposed solution, its novelty, the articulation of its business plan and the overall presentation skill. Each presentation was limited to 3 minutes, with 2 minutes at the end for Q&A. After an hour given for lunch, awards for the top 3 positions were announced.

Ethical Approval

Ethical approval was obtained from the Aga Khan University's Ethical Review Committee (ERC #9532389) prior to commencement of the study. Consent was

obtained for participation in the Hackathon and the subsequent incubation program via signed written documents.

Data Analysis

Data was entered and analyzed by using SPSS statistical package version 21. Participant demographics and professional affiliations were analyzed using frequencies for categorical variables. The post-Hackathon survey scores for each question were collected as answers on a Likert scale of 1–5 and presented as means and standard deviations. Information obtained from the incubate teams was semi-qualitative.

Results

From 273 applicants, 175 individuals were accepted, and out of those, 109 participants attended. There were 69 (68%) problem pitches made prior to team formation, and a total of 15 teams had formed that stayed and presented at the end of the event.

Demographics

The average age among all participants was 25.95 years (n = 102, SD = 6.91), with 46% of them being men and 54% being women. Three main profession groups were identified among the participants: nurses and nursing students, doctors, and medical students and nonmedical others (IT professionals, engineers, business people, public health specialists, etc.). The predominant demographic was from the doctors and medical students' group, with 75% of all participants hailing from it. The results table for the Hackathon lays out the complete distribution (Supplementary Appendix 2).

Additionally, there were 18 mentors present at the event, most of them surgeons or from other aspects of health care, some belonging to the spheres of IT and design, and a few were successful entrepreneurs and CEOs. These mentors were used to offset problems that teams were facing due to the lack of professional diversity within the team's participants. If a team needed engineering expertise but did not have a team member that was an engineer, for instance, they could ask a mentor with an engineering background for advice.

Pitch Distribution

Pitches presented initially before team formation could broadly be sorted into 5 categories; workplace, access, quality, safety, and design. In these 5 categories, the majority of pitches were made regarding access (n = 30, 43%) followed by quality (n = 27, 39%). By the time of the team formation phase, the number of teams tackling an area had equalized to 3 each. A summary of all pitches made has been given (Supplementary Appendix 3).

Post-Event Satisfaction

The results of our Hackathon post-event satisfaction survey were mostly positive (4.00, SD = .79), with high scores for whether the participants felt like their project was relevant and important (4.22, SD = .88), and whether they would continue working on it after the event (4.27, SD = .92). On the other hand, the Hackathon was criticized for not allowing enough time to work on projects properly (3.62, SD = 1.11), and the stressful schedule prevented participants from having fun (3.67, SD = 1.12). A full transcript of the results is included in Supplementary Appendix 4.

Incubation

Out of the 15 teams participating in the Hackathon, 7 applied to the in-house incubator at AKU, and 5 were selected.

Algos Health worked on the lack of a single data format regarding vitals monitoring of high-risk patients centrally in in-patient settings and planned to develop a suite of connected monitoring devices and an integrated software tool which would allow for seamless data sorting and visualization.

Maseeha Health realized the impoverished state of postoperative follow-up and developed a process innovation for patients to remain connected with care providers after discharge using a staffed team of nurses that would maintain communication with patients for this purpose.

Multilingual Health tackled the problem of language barriers in clinical encounters by developing a 2-way verbal communication application that would have inbuilt protocols such as pain assessment and diabetes explained in multiple regional languages.

Surgucator tackled the problem surrounding inadequate informed consent around surgical procedures by developing a web platform that would connect patients and their attendants with adequate knowledge about impending and advised procedures through digital content.

Surgit picked up on the broad range of anxieties—ranging from financial to social—that prevented patients from seeking necessary treatment once diagnosed and prescribed with surgeries and worked on a web-based community collaboration tool designed to provide awareness, access, and opportunity to patients requiring surgical intervention.

Discussion

As per selection into the incubation program, all categories of problem pitches at our Global Surgery

Hackathon were represented by at least 1 team. This shows that a Hackathon can provide a comprehensive exploration of the problems affecting an aspect of health care, and the follow through can work on each of these aspects and produce impact there.

Hackathons have a verifiable effect of quickly producing solutions to long established problems, and they do so via an entrepreneurial model.[10] In the context of the healthcare system, where traditionally an academic research-oriented approach of clinical trials is followed for new developments to be brought into practice,[11] a Hackathon will pick up problems that would not have been given attention by medical professionals, hence solving issues that greatly impact health outcomes without directly involving the healthcare system in the solutions' execution.[12]

Hackathons require a lot of diversity among their participants in order to achieve the largest possible solution pool, and the fact that most of our participants were medical personnel means that we were not able to optimize the Hackathon's possibilities. A majority of our participants were women (n = 69, 54%), however, which is a contrast to the demographics of most Hackathons held in the west.[13] Age-wise, the majority of our participants were from the 21 to 30 years bracket, which is the observed norm for most Hackathons.[14] This most likely happens because most Hackathons are organized by universities and so the student body ends up as a majority of the participating body.

To see if the issues tackled by this Hackathon are truly comprehensive with respect to our setting, we compared our results with those from Global Surgery Hackathons held elsewhere in the world (Supplementary Appendix 5). There are some noticeable differences. The winning teams in the global surgery Hackathon held by CAMTech in Uganda tackled problems relating to sterilization, niche preventive solutions, reproductive health, and digital screening, among others,[15] while those in the northeast Global Surgery Hackathon held at Harvard Medical School tackled problems relating to breast cancer, device distribution, sterilization, and digital identification, among others.[16] Our Hackathon did not involve teams with focuses in these problem spaces, which may be due to a lack of awareness of the importance of these issues, or the lack of respective staff (gynecologists, operating theater technicians, and engineers) in the participant pool. Our Hackathon, however, managed to focus a lot more on the patient experience in getting access to surgical care and developed solutions to enhance it.

Another major difference is the prize pool and funding available to teams from the other Hackathons. With overall funding gained being in the millions of dollars for teams coming out of other Hackathons, funding for our incubates did not exceed a single thousand dollars. Our teams have still managed to develop minimum viable products, however, and are moving toward execution. This highlights the lack of a start-up culture in Pakistan which deprives such events of funding, but also the frugality that solutions effective to our context exhibit.[17] It also highlights the importance of sponsorship for events like these, since the sponsors for the other Hackathons were largely responsible for the funding many of their winning teams received.[15]

This study's limitations include the use of a Likert scale in collecting post-event satisfaction statistics, which has disadvantages such as low resolution of data and the ultimately subjective nature of the questions being asked.[18] The analysis of impact is limited by a lack of available statistics and the projected nature of what these start-ups aim to accomplish. Furthermore, there were a lot of projects that were not pursued after the Hackathon that may have contributed to a better analysis of what problem areas a Global Surgery Hackathon is able to target and solve, thus leaving our information set incomplete. None of our start-ups have entered the market and so an informed commentary about their effectiveness cannot be given. Additionally, the participant distribution in terms of profession was heavily skewed toward medical professionals, which resulted in participants not tackling problems that needed the expertise of nonmedical professions, and coming up with app-based solutions in a majority of cases.

As regards to our solutions, each has potential to save quality-adjusted life years, and the amount can be calculated after collecting the relevant healthcare statistics. *Maseeha health*, for example, can significantly reduce the amount of postoperative mortality occurring due to negligence. Surveys can be done by *Surgit* to see how many patients are lost to follow-up due to a fear of the unknowns surrounding a surgery, and *Multilingual Health* can check their effectiveness against the total number of patients coming to a hospital that do not speak the majority language and are sidelined as a result.

In the future, the progress of all incubate teams from our Global Surgery Hackathon can be tracked, and their economic and quality-adjusted life-year impact can be quantified. An analysis of entrepreneurial medical/surgical interventions and their impacts on LMICs vs high-income countries health system economics is another promising avenue of inquiry.

Conclusion

Hackathons are a reliable way to come up with effective solutions for targeted problems in various areas of health care. Using the methodology, we followed to guide, critique, and structure the activities and progress of our participants, a pool of low-cost, innovative solutions that tackle a broad section of the overall problems in that area can be generated. These solutions can definitively impact

health outcomes, especially for the field of global surgery, due to the outstanding burden of disease and lack of infrastructure in LMICs. Further statistics need to be collected to affirm the impact of the incubated solutions.

Author Contributions

Dr Waqaas Akmal Butt is the first author and is responsible for writing the main body of the text. Dr Amir Shariff came up with the original concept and outline for this research article. Dr Sadaf Khan provided citable research material and a comprehensive global surgery perspective. Dr Asad Mian is the main proofreader, editor, and supervisor of this research study and is also the corresponding author.
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Acquisition of data: Sadaf Khan and Waqaas A. Butt
Analysis and interpretation: Waqaas A. Butt
Study Supervision: Asad I. Mian

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Supplementary Material

Supplemental material for this article is available online.

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